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Seabed Mineral Security as a part of Norway's Total Defence: Lessons from the Petroleum Sector

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Norway's total defence concept is built on a distributed responsibility model in which public authorities and private companies jointly contribute to national resilience. In the petroleum sector, this model has gradually evolved to include explicit security obligations, particularly after the Nord Stream sabotage, when gas transport to Europe was designated a fundamental national function under the Norwegian Security Act. This legal anchoring has clarified roles and risk ownership and enabled more coordinated responses to hybrid threats targeting subsea energy infrastructure. In contrast, the emerging seabed minerals sector lacks comparable institutional arrangements. Although the regulatory framework addresses safety, working environment, and environmental risks, security remains largely implicit and weakly integrated. This gap is noteworthy given the sector's vulnerability to grey-zone activities, cyber-physical sabotage, and geopolitical competition over critical raw materials. This paper compares governance developments in the mature petroleum sector with the nascent seabed minerals domain to examine how lessons learned can inform proactive security integration. The analysis shows that intentional threats cannot be governed through safety-based regulation alone; effective management of hybrid threats requires early state involvement, clear role allocation, and mechanisms for information sharing and civil–military cooperation. The petroleum experience also demonstrates that retrofitting security regulation onto established safety regimes creates friction, including classification barriers, uneven access to threat information, and coordination challenges across agencies and operators. We conclude that security must be designed into the seabed minerals framework from the outset to avoid similar governance gaps.

Keywords: Seabed Minerals, Petroleum, Security, Regulation, Responsibility, Total defence

1. Introduction

Seabed minerals represent both a strategic opportunity and a growing security challenge for Norway, as rising global demand for critical minerals has turned the deep seabed into a new arena of geopolitical competition (Zhiyenbayev, 2025). Increased interest in maritime areas and mineral access may also create new security pressures in Norwegian waters, strengthening the case for integrating seabed resource protection into Norway's total defence framework (National Security Strategy 2025; NOU 2023:14; NOU 2023:17).

Norway's total defence model is based on distributed responsibility across public authorities and private actors (NOU 2023:14; NOU 2023:17). In high-risk sectors such as petroleum, this has developed into explicit security obligations, including the application of the Norwegian Security Act. By contrast, seabed mineral activities remain in early, exploratory phases, raising questions about how safety and security should be integrated into the governance of a potentially strategic future industry. This concern persists even if extraction does not proceed, as foreign mapping expeditions are already generating data, experience, and technological advantages in Norwegian waters, underscoring the need for Norwegian presence, oversight, and knowledge development (Trellevik & Svellingen, 2026).

The government expects significant mineral resources on the Norwegian continental shelf

(THEMA Consulting Group, 2025). If extraction proves economically and technically feasible, seabed minerals may contribute to national value creation and secure supplies of critical raw materials for the global energy transition. One area of the shelf has already been opened for mineral activities, and the government aims to position Norway as a world leader in sustainable and responsible seabed mineral management, grounded in scientific knowledge and a precautionary regulatory approach (Government.no, 2025).

Countries such as the United Kingdom, the United States, Brazil, and Australia have developed extensive regulatory frameworks that combine resource management, safety, environmental protection, and other societal considerations. Although institutional arrangements vary, a common feature is the central role of the state in establishing rights regimes, exercising regulatory oversight, and balancing commercial interests with broader public concerns. These experiences provide an important backdrop for the emergence of regulatory frameworks for new offshore activities, including seabed mineral extraction, where many of the same governance challenges apply, albeit under conditions of significantly greater scientific and operational uncertainty.

At present, governance of seabed-mineral activities on the Norwegian continental shelf is primarily structured through safety, working-environment, and environmental regulation, while security considerations remain largely implicit and institutionally under-specified. Because no production concessions have yet been awarded, the regulatory framework remains in an early and formative stage. This early phase nevertheless creates a critical window of opportunity to draw on lessons from another maritime sector that has recently become an integral component of Norway's total defence: the petroleum sector. Following the Nord Stream sabotage, the designation of gas transport by pipeline to Europe as a fundamental national function and the inclusion of key petroleum operators under the Security Act serves as a comparative case that can offer valuable and transferable insights for shaping a proactive security governance framework in the emerging seabed-minerals domain, before strategic infrastructure, actor constellations, and operational practices become locked in. This paper aims to address two research question; (1) How has the integration of the Security Act into the Norwegian petroleum sector clarified responsibility and risk ownership, and what lessons may be drawn for the governance of security in future seabed mineral activities? (2) To what extent does the current, safety-oriented regulatory framework for seabed mineral activities leave open questions regarding security governance, and how might Norway's total defence principles be adapted should the sector develop further?

To address these research questions, the paper first gives a short account of the theoretical and empirical foundation for this paper. Next, the Norwegian total defence model is presented and the role and lessons learned from the petroleum sector is discussed. Thereafter, we examine how the emerging regulatory framework for seabed mineral activities primarily addresses safety risk through safety- and function-based regulation, while security risks remain largely implicit. Through a comparative analysis of an emerging and a mature sector, the paper seeks to identify governance gaps and discusses the implications of integrating intentional threats into established safety-oriented regulatory regimes.

2. Theoretical and empirical foundation

We apply a theoretical framework that combines insights from collaborative governance (Ansell et al., 2024) and co-creation theory (Skare and Jore, 2024), complemented by perspectives from regulation theory (Engen and Lindøe, 2017, Hagen et.al., 2025). Hybrid threats, characterized by ambiguity, cross-sectoral interdependencies, and activities below the threshold of armed conflict (Bjørge & Høiby, 2025), challenge traditional state-centric security models by creating governance demands that span administrative, jurisdictional, and sectoral boundaries (Skare and Jore, 2025). In response, the paper draws on collaborative governance and co-creation theory to examine how resilience must be co-produced across institutional interfaces, involving public authorities, private companies, and civil society, and how trust, knowledge exchange, and role clarity become critical to effective collaboration. Regulation theory enables us to analyse how responsibilities, authority, and control are distributed across state

and non-state actors, and how regulatory gaps or ambiguities emerge when new sectors develop faster than their institutional frameworks.

Empirically, the analysis integrates two distinct data foundations. The empirical data from the Norwegian petroleum sector is collected through the research project INTERSECT, which research consequences of the implementation of the Security Act in the Norwegian petroleum sector. The empirical material on seabed mineral activities is derived from written sources, including policy documents and publicly available reports. Together, these theoretical and empirical components allow us to explore how emerging industries, such as seabed minerals, might develop clearer security governance arrangements by drawing lessons from more mature sectors while also addressing the unique regulatory challenges posed by hybrid threats.

3. Lessons learned from the petroleum Sector in Total Defence

Norwegian Total Defence historically evolved around state and societal security, not around strategic industrial sectors, leaving industries like petroleum and seabed minerals outside the core of Norwegian national security governance until recently. During the Cold War, the concept of total defence focused on mobilising society to support the Armed Forces in the event of a military invasion. The objective was state survival, and civilian actors, including industries, were understood mainly as support resources, not as strategic sectors with defined security responsibilities.

In the post–Cold War period, the focus shifted toward broader societal security challenges such as terrorism, natural disasters, and technological breakdowns. Although this period expanded security cooperation across civilian authorities, it still did not integrate industries directly into Total Defence structures. The petroleum sector, despite its growing economic importance, was not formally treated as part of national security governance.

The contemporary phase of Norway's total defence reflects a security environment defined by hybrid threats, cyber operations, sabotage, disinformation, and intensified geopolitical competition. The contemporary Norwegian Total Defence blends elements of earlier models but expands the concept to cover the full spectrum from peace to crisis to armed conflict. It requires close integration of military and civilian capabilities, and emphasises cooperation among public authorities, private companies, critical infrastructure operators, voluntary organisations, and the general population. This broadening introduces new dilemmas concerning democratic legitimacy, civil–military boundaries, and the risk of militarisation within traditionally civilian sectors (Jore and Engen, Forthcoming).

In its modern interpretation, total defence is a comprehensive all of society-security architecture designed to protect both state security and critical societal functions. (Jore & Engen, Forthcoming; Norheim-Martinsen, 2019; Rongved, 2025). What distinguishes today's total defence model from earlier versions is that civilian industries are no longer peripheral: they are now central actors in national security. This shift reflects the nature of hybrid threats, which target economic leverage, infrastructure vulnerabilities, and digital interdependencies rather than only military assets.

The petroleum sector exemplifies this development. As documented in Norwegian official assessments, hybrid threats increasingly target energy infrastructure through cyber operations, espionage, and possible sabotage, with foreign actors mapping vulnerabilities in Norwegian oil and gas systems (Meld. St. 9 [2024–2025]). The geopolitical aftermath of Russia's full-scale invasion of Ukraine and the sabotage of the Nord Stream pipelines transformed Norwegian petroleum from an economic asset into a strategic security sector. This led to the designation of gas transport to Europe as a fundamental national function under the Security Act, marking the first time the petroleum value chain was formally incorporated into national security governance. In this modern framework, the petroleum sector is expected not only to secure its own infrastructure but also to contribute directly to national resilience. This represents a major shift: historically, total defence was not tied to specific industries, but today's threat landscape requires strategic public and private industrial sectors to be integrated into national security planning. As new domains such as seabed minerals emerge, similar pressures are likely to arise. These sectors risk becoming strategically significant before coherent security governance structures are in place.

Prior to the Nord Stream sabotage and before parts of the petroleum sector were brought under the Security Act, companies overwhelmingly understood the prevention of hybrid threats as a governmental responsibility, not a corporate one (Skare and Jore, 2025). Their own obligations were understood to lie in protecting business continuity and securing their assets, rather than contributing to national-level threat detection or countering state-driven hybrid activities. The Nord Stream sabotage in 2022, combined with the formal subjection of key operators to the Security Act thereafter, fundamentally altered this understanding. These developments led to a rapid and profound shift in expectations and practice, whereby companies were redefined as integral security actors with explicit responsibilities for monitoring, assessing, and mitigating hybrid threats within the framework of Norway's modern total defence model.

Norway's petroleum sector has demonstrated notable strengths that are directly transferable to the modern total defence architecture. First, it possessed rapid mobilisation capacity and deep technical capability for subsea inspection and remediation, enabling swift, large-scale cooperative operations with authorities after the Nord Stream sabotage (e.g., the multi-actor effort to inspect and clear ~9,000 km of pipelines within months). These capabilities rest on decades of HSE practice, asset integrity management, and established liaison mechanisms, now repurposed to support security tasks. Second, institutionalised collaboration through extraordinary cross-actor meetings, the Maritime Security Network, and expanded liaison arrangements, has accelerated information exchange and operational synchronisation between military, police, regulators, and operators. Third, the sector brings significant resources and situational awareness to a domain where public capacity is limited: industry expertise, surveillance platforms, and willingness to protect own infrastructure have proven pivotal.

However, the sector's experience since 2022 also reveals persistent challenges in the security governance. Information-sharing frictions has arisen from classification barriers, incompatible secure-communications solutions, and uneven access to graded data which undermine shared situational awareness across tripartite partners and slowing time-critical decisions (Jore, Engen, Hansen and Midttun, forthcoming). Role ambiguity and jurisdictional complexity persist in international waters and across multilateral infrastructure, complicating lines of authority between police, military, regulators, and industry, and raising legal uncertainties under law-of-the-sea and overlapping security regulations.

The regulatory turn in 2022 which integrated the Security Act and designating gas transport to Europe as a fundamental national function has been decisive in clarifying responsibility and risk ownership and in enabling lawful intelligence sharing with key operators (e.g., Equinor, Gassco). It also catalysed rapid company-level adjustments of security plans and procedures, illustrating how legal instruments can activate industry contributions to national security. Yet implementation exposed scope ambiguities, delayed identification of protected assets, and uneven application across companies which are typical of adding intentional-threat governance to a mature safety regime.

A key lesson from the petroleum sector is the importance of regulatory clarity regarding responsibility and risk ownership (Årstad & Engen 2018). By designating petroleum production and gas transport to Europe as fundamental national functions, the Security Act clarified that these activities fall within the scope of national security governance. At the same time, implementation revealed the challenges of introducing security regulation in an already mature sector, including uncertainty about scope, delayed identification of protected assets, and uneven application across companies. These experiences suggest that security regulation is more effective when institutional roles and supervisory responsibilities are clearly defined at an early stage, rather than added incrementally to a safety-based framework.

The petroleum case also illustrates both the strengths and limits of risk-based, function-oriented security regulation. While the Security Act assigns primary responsibility for threat assessment and preventive measures to private operators, in line with Norway's tradition of enforced self-regulation, experience shows that companies often lack the competence, intelligence access, and analytical tools needed to assess hybrid and geopolitical threats. As a result, effective security governance depends on close

interaction with state authorities, highlighting that security cannot be fully privatized even within a distributed responsibility model. These insights are particularly relevant for seabed mineral activities, which are emerging in a technologically complex, remote, and geopolitically sensitive domain and currently lack an explicit security framework and expertise assigning formal responsibility for protecting the value chain.

Hansen and Antonsen (2024) emphasise that contemporary risk governance must explicitly address the interconnectedness of safety and security, particularly in sectors with strategic infrastructure. They show that geopolitical threats cut across organisational and sectoral boundaries, challenging governance models built primarily around safety. Because safety and security follow different logics—accidental versus intentional harm, openness versus secrecy, and probabilistic versus intelligence-based knowledge—their coexistence creates persistent coordination challenges. For seabed minerals, this implies that security cannot be treated as a mere extension of safety management but requires a multi-level, multi actor governance approach. Early integration of security considerations is therefore essential to avoid the coordination problems, legitimacy issues, and crisis driven interventions seen in the petroleum sector following sudden geopolitical shocks.

Compared to other countries, Norway's total defence model stands out through unusually close civil–military–industry cooperation, which enables faster mobilisation than in more segmented governance systems such as the UK, US, or Germany. However, the Norwegian approach shares limitations observed elsewhere, including challenges tied to classified information, jurisdictional ambiguity, and tensions between safety-driven industry practices and security-driven military requirements.

4. Safety and security regulation for seabed mineral activities in Norway

Seabed mineral activities on the Norwegian continental shelf are regulated under the Havbunnsmineralloven (2019), which requires that operations be conducted in a sound manner that safeguards life, health, the environment, and material assets. The Act builds on principles from offshore petroleum regulation and mandates a high and continuously improving safety level. Regulatory responsibility for safety, working environment, and emergency preparedness lies with Havindustritilsynet (Havtil), which in 2025 proposed a dedicated regulation for offshore mineral activities. This regulation is risk based and function oriented, requiring operators to identify hazards, assess major accident risk, establish technical and organisational barriers, and maintain robust emergency preparedness. Working environment legislation (Arbeidsmiljøloven) applies fully to seabed mineral activities, including requirements related to physical, chemical, ergonomic, and psychosocial factors.

Where activities are conducted from vessels, maritime safety legislation such as the Ship Safety Act applies in parallel, and operators must ensure coherent coordination between maritime and offshore industrial rules. Although the regulatory framework is primarily shaped around safety, it carries clear security implications. Remote operating areas, long emergency response times, reliance on digital navigation and communication systems, and the potential introduction of permanent installations create vulnerabilities related to access control, infrastructure protection, and resilience against intentional acts. Security is currently addressed implicitly through general requirements for risk management, barrier integrity, and preparedness. This provides flexibility but also entails the risk that malicious threats, hybrid risks, and geopolitical dimensions may not be systematically assessed. As the sector moves from exploration toward potential extraction and infrastructure becomes more permanent, there is an increasing need to clarify and strengthen the security dimension within the existing safety-based regime to ensure that intentional threats are handled with the same rigour as accidental risks.

4.1. The Norwegian regulatory concept for natural resources

Hagen et al. (2025) highlight that the current safety oriented regulatory framework for seabed mineral activities leaves key aspects of security governance unresolved. Their historical analysis of high risk, resource-based sectors such as hydropower and offshore petroleum demonstrates

the importance of establishing holistic, function-based regulatory regimes early, combining ownership control, safety regulation, preparedness, and strong governmental oversight. This trajectory resembles the emerging framework for seabed minerals, yet the comparison shows that while safety and occupational risks are addressed, broader security issues related to strategic interests, critical infrastructure protection, and civil military coordination remain insufficiently articulated.

Hagen et al. (2025) also illustrate the consequences of delayed or fragmented regulation in newer sectors such as wind power, aquaculture, and digital infrastructure, where insufficient early integration has led to blurred responsibilities, control gaps, and greater vulnerability to both safety and security risks. These lessons are directly relevant for seabed minerals, a sector developing under technological uncertainty, remoteness, and increasing geopolitical and cyber related threats. A central argument in Hagen et al. (2025) is the distinction between safety and security. Function-based safety regulation is well suited for managing operational and major accident risks, but security remains weakly governed unless explicitly integrated. For seabed mineral activities, likely to involve critical infrastructure, sensitive data, and strategically important resources, this underscores the need to embed security early, before institutional path dependencies take hold. Engen and Lindøe (2017) reinforce these insights by describing the Nordic Model as a governance system characterized by strong state involvement and institutionalised cooperation between authorities, industry, and labour organisations. While robust in mature sectors like petroleum, the model presupposes established institutional relationships, conditions not yet present in the emerging seabed minerals industry

These insights are reinforced by Engen and Lindøe (2017), who describe the Nordic Model as a regulatory and governance approach characterized by strong state involvement combined with institutionalised cooperation between authorities, industry, and labour unions. In offshore petroleum regulation, this model is operationalised through enforced self-regulation, where the state defines function-based legal requirements while delegating responsibility for risk identification and mitigation to industry actors, under the supervision of a competent regulator. The robustness of this model lies in its capacity for learning and adaptation through incremental regulatory refinement, particularly following major accidents. However, Engen and Lindøe also stress that the model presupposes a relatively mature industry and well-established institutional relationships.

Engen, et al (2023) further conceptualise risk governance as a polycentric regulatory regime in which safety is produced through the interaction of multiple institutional logics rather than through hierarchical command and control alone. In the offshore petroleum sector, function-based regulation, enforced self-regulation, and extensive use of standards have enabled authorities to delegate operational responsibility for risk management to industry actors while retaining strong supervisory capacity and legitimacy. This model has proven robust in addressing complex and uncertain accident risks, particularly through tripartite cooperation and continuous learning. At the same time, this paper further stress and highlights how such regimes are historically oriented toward accidental risk and presuppose relatively stable threat environments, high levels of trust, and mature institutional arrangements. As risk governance expands beyond traditional safety concerns, these assumptions become increasingly strained, suggesting that established safety-based regulatory architectures may face limitations when confronted with intentional, strategic, and politically motivated threats. Applied to seabed minerals, this suggests that while the Nordic Model offers a valuable template for safety and security governance, its successful transfer depends on early clarification of roles, responsibilities, and state involvement in a domain marked by technological novelty and strategic uncertainty.

Self-regulation in the petroleum sector represents a Nordic regulatory concept grounded in trust and dependent on highly competent industrial actors. Such arrangements are not easily transferable to countries with different regulatory cultures. However, elements of this model can be adapted, organised, and institutionalised in other contexts, as illustrated by developments in the British and even the Brazilian offshore sectors. In the offshore petroleum sector, function-based regulation, enforced self-regulation, and the

extensive use of standards have enabled authorities to delegate operational responsibility for risk management to industry actors while retaining strong supervisory capacity and regulatory legitimacy. This model has proven robust in addressing complex and uncertain accident risks, particularly through tripartite cooperation and continuous learning.

Applied to seabed minerals, this implies that while the Nordic model offers a valuable template for safety and security governance, its successful transfer depends on the early clarification of roles, responsibilities, and the degree of state involvement in a domain characterised by technological novelty and strategic uncertainty.

5. Conclusion

This paper has argued that Norway's emerging seabed minerals domain sits at a strategic inflection point: security remains largely implicit within a safety oriented regulatory architecture, while the geopolitical importance of subsea minerals is rapidly increasing. A central factor intensifying this vulnerability is the structure of global supply chains. China currently controls around 90 percent of several critical mineral processing and refining chains, creating dependencies that heighten risks of strategic acquisitions, corporate influence operations, and covert attempts to shape regulatory development in emerging industries. Such patterns raise concerns that similar tactics could be employed in the seabed minerals domain as commercial actors enter the Norwegian continental shelf. These dynamics strengthen the argument that security considerations must be integrated from the outset, not retrofitted once the industry matures.

The petroleum sector provides important lessons in this regard. Its experience shows that legal clarity, routinised state industry interfaces, and interoperable information flows are essential for effective total defence integration. Applying these insights while the seabed minerals regime is still malleable can prevent governance gaps, reduce crisis driven improvisation. The petroleum experience also demonstrates that industry can function as an effective coproducer in total defence by contributing rapid mobilisation capacity, subsea competence, and resources that complement limited public capabilities. At the same time, retrofitting security governance onto a mature safety regime created frictions such as classification barriers, incompatible secure communications, uneven access to graded information, and unclear roles across jurisdictions and actors.

Comparatively, the Norwegian total defence approach in the petroleum sector benefits from strong civil military industry cooperation and long-standing liaison structures. Many other developed states organise maritime and energy infrastructure protection through more fragmented sectoral arrangements with clearer boundaries between state security functions and industry led protection. Norway's rapid alignment across the Armed Forces, police, regulators, and operators after the Nord Stream sabotage was enabled by pre-existing relationships and coordination arenas. Yet the model faces similar structural limitations seen internationally, including challenges with handling classified information, legal ambiguity in international waters, friction between safety oriented industrial logics and security driven military logics, and uncertainty about responsibilities during high end crises. Thus, while Norway's model enables rapid cross-sector mobilisation, it still confronts constraints typical of hybrid maritime threat environments.

Extending these insights to seabed minerals underscores the importance of early institutional design. Activities will unfold in remote, technologically novel, and geopolitically sensitive areas, where strategic foreign influence, supply chain pressure, and attempts at covert data harvesting may accompany commercial engagement. Relying solely on implicit, safety-oriented frameworks risks reproducing the frictions documented in the petroleum sector: classification bottlenecks, uneven secure communications, unclear escalation expectations, and coordination challenges across civil military boundaries. A prudent approach is therefore to combine Norway's function-based enforced self-regulation with explicit security objectives and early state anchoring.

The seabed minerals analysis relies primarily on documentary sources, reflecting the sector's nascency. As activities advance, field-based data should be gathered on operator capabilities, supply chain exposure, and civil military coordination in remote operations. Comparative studies across Nordic and allied jurisdictions may clarify which elements of Norway's model are

transferable and where clearer state delineation of security roles, as found elsewhere, could strengthen a proactive and hybrid threat aware governance architecture for a strategically significant future industry.

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